PROCEEDINGS

OF

THE ROYAL SOCIETY.

1847. No. 70.

November 25, 1847.

GEORGE RENNIE, Esq., Treasurer, in the Chair.

His Grace the Duke of Wellington was elected a Fellow of the Society.

Postscript to Mr. W. H. Barlow's paper on Alternating Diurnal Currents of Electricity at the Terrestrial Surface.

The author states that since his paper was read to the Society, he had made further experiments to determine with greater accuracy the direction in which the daily electrical currents travel, and also how far the motions of the horizontal magnetic needle correspond with that of the telegraph. With regard to the latter, he finds that although they agree as to the general character of their deflexions, there is no decided simultaneous coincidence in their movements.

"Magnetical experiments on board H.M. Iron Steam Vessel 'Bloodhound.'" By Captain Edward Johnson, R.N., F.R.S. Communicated to the President by the Lords Commissioners of the Admiralty, and communicated to the Society by the President.

These experiments were undertaken with the view of ascertaining whether the action of steam upon the hull of an iron vessel affects a compass, properly placed, in any degree that may be of practical importance in its navigation; and also whether the keeling of the vessel produces any alteration in the deviations, or disturbs a compass so placed to any considerable extent. The former question is, from the results of these experiments, resolved in the negative; but with respect to the second, it appears that the deviations produced by keeling are very marked, and could not be safely disregarded. These observations completely confirm those already made by Mr. Walker and Commander Shaugh on board H.M. Iron Brig 'Recruit,' Commander A. Slade, and they prove the necessity that exists for ascertaining the deviations of the compass in all ships, not only at the beginning and end of their voyage, but likewise at intermediate

stations; as also constant observation of the course which the ship may be steering.

December 16, 1847.

Sir ROBERT HARRY INGLIS, Bart., V.P., in the Chair.

"Thirteenth Series of Tide Researches." By the Rev. William Whewell, B.D., F.R.S.

The first part of this paper, "*On the Tides of the Pacific*," forms a sequel to former papers by the same author, especially to his first memoir on this subject, printed by the Royal Society in 1833 ('Essay towards a first approximation to a map of Cotidal Lines'), and to the *Sixth Series* published in 1836 ('Results of an extended series of Tide Observations made on the coasts of England and America in June 1835'). Among the results obtained in the latter paper, it appeared that all the "cotidal lines" which have been most exactly traced, meet the coast at a very acute angle; and for that and for other reasons stated in other memoirs, the drawing of cotidal lines across wide oceans is a very precarious process. In addition to this consideration, the scantiness of our materials has hitherto made it impossible to trace the tides of the Pacific in a connected form; and the absence of lunar tides in the central parts of that ocean (as at Tahiti) makes it difficult to represent the course of the tides by means of cotidal lines at all. We are thus led to consider in what other way the course of the tides over wide spaces may be represented: and it is stated by the author, that either a *stationary undulation*, or a *rotatory undulation*, of the central parts of an ocean, with a border of cotidal lines proceeding outwards from the central undulation into bays and arms of the sea, would represent, in a great measure, the tidal phenomena of the Atlantic and Pacific, as far as they are known. The *rotatory undulation* here spoken of need not be understood to be a *rotatory motion* of the water, but a geometrical rotation of the cotidal line, such as takes place in the German Ocean; the tide in the central part (that is, the rise and fall of the surface) vanishing, as was shown by the observations of Capt. Hewett, though the tidal currents at that point alternate regularly. Such a movement of the cotidal line may perhaps represent the phenomena of the North Pacific.

The author has collected materials for a Tide Map of the Pacific from various navigators;—Cook, Flinders, King, Captains FitzRoy, Sir E. Belcher, Sir James Ross, Stokes, Killet, and others of our own countrymen; Malaspina, Freycinet, Du Petit-Thouars, Wrangel and Admiral Lütke, and other Spanish, French and Russian navigators. The result of these appears to be, that on the eastern coast of the Pacific, the tide comes from the west; arrives first at the coast near Acapulco and Nicoya, and is later and later both to the north and to the south of this point; passing to the eastward round Cape Horn, as observed by King, and to the northward along the coast

of North America, and then to the westward along the Aleutian Isles, and so to Kamtschatka, as stated by Admiral Lütke.

The tides in the centre of the Pacific are too small and anomalous to allow us to trace the connection among them. At Tahiti, according to the observations of Sir Edward Belcher, the solar and lunar tides appear to be equal.

The tides have been traced along the coasts of New Zealand and Australia by Cook, Flinders, and other succeeding navigators. They come from the east; and the cotidal lines which mark their progress appear to have a north and south range, except when deflected by passing round promontories and the like. When we pass westward from the eastern coast of Australia, the cotidal lines are too much broken and complicated by the intervention of islands, to be traced with our present materials of knowledge.

The second part of the memoir, "*On the Diurnal Inequality*," treats of the difference of the two tides of the same day, which has also been discussed in former memoirs by the author, and its laws so fully made out, that this inequality has been introduced into the tide tables for Liverpool and for Plymouth. This inequality depends mainly on the moon's declination. In England it is small: it is very marked on the coasts of Spain, Portugal and North America, as was shown by the observations of 1836: but in the North Pacific and in the Indian seas, it reaches an enormous amount, and shows itself with curious differences. In many places in those seas, the diurnal inequality is much larger than the differences of spring and neap tides, and is so large as utterly to confound the usual modes of estimating the "establishment" of a place.

This inequality affects the tides of various parts on the coast of Australia to a very great amount, and with very remarkable differences. It is seen at Adelaide on the south, and Port Es ington on the north coast; and at each place it produces a difference of several feet between every two successive tides, when it is at its maximum: but this difference affects mainly the *high waters* at Adelaide and the *low waters* at Port Essington*. Also on the west coast of Australia, near Swan River, the diurnal inequality appears with another peculiarity, affecting the times of high water rather than the heights. These differences, the author remarks, show that the diurnal wave travels separately from the semidiurnal wave; but our materials do not at present enable us to analyse the compound tide into these two waves, and to trace the course of each.

The author observes, in conclusion, that our knowledge of the tides is not likely to be completed, nor even much advanced, by tide observations made by navigators and surveyors voyaging with other main objects. The later observations of the Pacific, though made with great industry, have added little to the knowledge derived from Cook, Flinders and King, because they were not geographically connected with each other: and the great discrepancies of the obser-

* These results follow from a series of tide observations made at Adelaide by Mr. Bealten, and at Port Essington by Sir Gordon Bremer.

vations at the same place show how little correctness the mean of them, or the result, however obtained, can pretend to.

The results of the recent observations, with which the author has been furnished by various navigators and by the Hydrographer's Office, have been obtained by throwing the observations into curves, according to methods formerly used and described by the author. This labour has been carefully performed by Mr. D. Ross of the Hydrographer's Office.

January 6, 1848.

GEORGE RENNIE, Esq., Treasurer, in the Chair.

"On Terrestrial Magnetism." By William A. Norton, A.M., M.A.P.S., Professor of Mathematics and Natural Philosophy in Delaware College, United States of America. Communicated by Lieut.-Colonel Edward Sabine, R.A., For. Sec. R.S.

The object of the author in the present memoir is to show that, by adopting certain fundamental conceptions with respect to the terrestrial magnetic forces, the magnetic may be deduced from the thermal elements of the earth. The following are the propositions which he considers he has established by his inquiries.

1. All the magnetic elements of any place on the earth may be deduced from the thermal elements of that place; and all the great features of the distribution of the earth's magnetism may be theoretically derived from certain prominent features in the distribution of its heat.

2. Of the magnetic elements, the horizontal intensity is nearly proportional to the mean temperature, as measured by Fahrenheit's thermometer; the vertical intensity is nearly proportional to the difference between the mean temperatures, at two points situated at equal distances north and south of the place, in a direction perpendicular to the isothermal line; and, in general, the direction of the needle is nearly at right angles to the isothermal line, while the precise courses of the inflected line, to which it is perpendicular, may be deduced from Sir David Brewster's formula for the temperature, by differentiating and putting the differential equal to zero.

3. As a consequence, the laws of the terrestrial distribution of the physical principles of magnetism and heat must be nearly the same; and these principles themselves must have towards one another the most intimate physical relations.

4. The principle of terrestrial magnetism, in as far as the phenomena of the magnetic needle are concerned, must be confined to the earth's surface, or to a comparatively thin stratum of the mass of the earth.

5. The mathematical theory of terrestrial magnetism which has been under discussion must be true in all its essential features.

6. We may derive the magnetic elements by very simple formulæ, and with an accuracy equal to that of Gauss's formulæ, from a very

small number of magnetic data determined by observation, and the mean annual temperature of the place.

January 13, 1848.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

"On the Disruptive Discharge of accumulated Electricity, and the Proximate Cause of Lightning." By Isham Baggs, Esq. Communicated by S. Hunter Christie, Esq., Sec. R.S.

The author proposes to inquire into the principal causes of the violent and disruptive union of opposite electricities which constitutes the electric discharge; and to apply the knowledge thus gained to the explanation of natural phenomena, and the further proof of the identity of frictional and voltaic electricities. He describes two instruments which he employed for the purpose of regulating the discharges of a Leyden jar, or battery, by adjusting with precision the distances between two brass balls, forming a communication between the inner and outer coatings; allowing of their being charged only to a limited degree of intensity, by carrying off all the electricity beyond that extent; and thus guarding the glass from the dangers of fracture from an excess of charge. He is led to the conclusion, that with a given dialectric, such as glass, the limit to the intensity of the charge it can receive varies directly as the cube of its thickness, being in the compound ratio of the resistance it presents to the discharge, which is simply as the thickness, and of the square of the distance of the two charged surfaces, such being the law of electric action.

When a number of insulated Leyden jars, arranged in a consecutive series by connecting the outer coating of each with the inner coating of the next, is charged by means of an electrical machine, the tension of the charge diminishes in each jar as they follow in the series, that of the terminal jar being exceedingly small. On the other hand, when each jar has been charged separately in the same manner and to an equal extent, and then quickly arranged in a series, the jars not touching one another, but the knobs connected with the inner coating of each jar, after the first, being placed at a certain distance from the outer coating of the preceding jar, which in such an arrangement is charged with an electricity of an opposite kind to that of the knob adjacent to it, the author found that the tension of the electricities was greatly augmented, giving rise to violent explosions whenever a discharge occurred. He considers a battery thus constituted as bearing the same relation to a single Leyden jar as the voltaic pile does to a single galvanic circle; and as affording in like manner the means of exalting, to any assignable degree, the electric tension. Adopting the views of Mr. Crosse as to the constitution of a thunder-cloud, namely, that it is formed of a number of concentric zones of electricity, alternately positive and negative,

the central one having the highest intensity, and the tension diminishing in the successive zones surrounding the innermost, till it became inappreciable in the one most remote; the author considers this condition of the cloud to be analogous to that of the battery above described, and the phenomena of the former to receive complete illustration from the experimental results obtained with the latter.

January 20, 1848.

GEORGE RENNIE, Esq., Treasurer, in the Chair.

"On the Heat disengaged during Metallic Substitutions." By Thomas Andrews, M.D., M.R.I.A., Vice-President of Queen's College, Belfast, &c. Communicated by Michael Faraday, Esq., D.C.L., F.R.S. &c.

In a paper which was published in the Philosophical Transactions for 1844, the author deduced from the experimental inquiry there recorded the general law, that when one base displaces another from any of its neutral combinations with an acid, the heat evolved or abstracted is always the same, whatever that acid element may be, provided the bases are the same. Extending a similar inquiry to salts with metallic bases, he establishes, as the result of the investigation of which an account is given in the present paper, the general principle that when an equivalent of one and the same metal replaces another in a solution of any of its salts of the same order, the heat developed is, with the same metals, constantly the same, the expression "of a solution of the same order" being understood to mean a solution in which the same precipitate is produced by the addition of an alkali, or, on one view of the composition of such salts, in which the metal exists in the same state of oxidation. The metallic salts, in the precipitation of which by other metals the evolved heat was ascertained, were those of copper precipitated by zinc, iron or lead; of silver, precipitated by zinc or copper; and of lead, mercury, and platinum precipitated by zinc: and the acid elements were either the sulphuric, hydrochloric, acetic or formic acids. From the last series of experiments the author deduces, that if three metals A, B, and C, be so related that it is capable of displacing B and C from their combinations, and also B capable of displacing C, then the heat developed in the substitution of A for C will be equal to that developed in the substitution of B for C; and a similar rule may be applied to any number of metals similarly related.

January 27, 1848.

GEORGE RENNIE, Esq., Treasurer, in the Chair.

"On Galvanic Currents existing in the Blood." By James Newton Heale, Esq., Licentiate of the Royal College of Physicians, and

Fellow of the Royal College of Surgeons of England. Communicate by P. M. Roget, M.D., Sec. R.S.

The following abstract of this paper has been drawn up by the author.

The author endeavours to prove, by inductive reasoning and by historical considerations of the earliest indication of vitality in the egg, that motion of a fluid in a certain definite circle constitutes the first link in the chain of causes by which vitality is perfected; that all the other phenomena of living structure are supplementary and superinduced upon this primary and indispensable condition; and that, although it might be possible to maintain this primary circulation under certain circumstances, even though all the other functions of life were suspended or destroyed, they, on the contrary, cannot exist independently of that circulation. He shows it to be necessary to circulation, that two fluids, or a fluid in two different states, should communicate by two points or extremities with each other, and that these extremities should present such a resistance to their mutual connexion and commixion, that the transfer of conditions of each, from one to the other, must take place, otherwise the uniformity of both would speedily put an end to the process; and it is indicated that the forces in operation in these two places would be reverse to each other; in the one it would be from arterial to venous, and in the other from venous to arterial.

The blood-vessels containing the two kinds of blood are compared by the author to two bar-magnets placed side by side, the pulmonary and systemic capillaries representing the armatures placed at their extremities; with this limitation, that as the changes in the blood take place only in the two opposed sets of capillaries, the force is necessarily generated only in them, and therefore the intermediate blood contained in the larger blood-vessels merely represents conducting wires completing the circuit. The left side of the heart is viewed as being placed in the largest ampulla of the arterial circulation, and the right side of the heart as being in the like position with respect to the venous current.

The portal circulation is alluded to, in order to prove that a propelling force is not essential to produce circulation of blood. An account is given of numerous experiments on various animals, in which the ends of two similar wires (in some cases of copper and in others of platinum) were inserted; that of the one into a vein, and that of the other into an artery, the free ends of both wires being brought into connexion with a delicate galvanometer; and it was found that during life a galvanic current was indicated, passing along the artery and returning by the vein; that this current became more feeble in proportion as the vitality of the animal declined, and again more strong as the effect of the chloroform, which was administered for the purpose of preventing pain, subsided.

The author also observed, that the strong action of a muscle (the sterno-mastoid) between the two blood-vessels tended to discharge the galvanic force as it was generated; and that when that muscle was divided, the galvanic force became much stronger. When the

connexion of the current with the lungs was severed by a ligature placed on the vein between the insertion of the wire and the heart, the current was instantly reversed, passing up the vein and returning by the artery. The same reverse current was indicated when the wires were inserted into portions of the blood-vessels which had been isolated, each by two ligatures, placed the one above and the other below the insertion of the wires. A similar effect was also obtained, as long as the blood continued to coagulate, when the two kinds of blood were drawn from the blood-vessels into separate cups, and brought into connexion with the galvanometer; the blood in the cups being connected together by the ends of a piece of copper or of a strip of muscle dipping into each.

Several experiments are related, tending to prove that the power which fluids, differing chemically from each other in however great a degree, were supposed to possess of acting chemically upon the copper wire, and thus generating currents, had been greatly exaggerated; and that much which had been attributed to this cause deserved rather to be ascribed to the polar forces, which the fluids had a tendency to assume, being discharged through the copper as a conductor, since the same effect was produced when platinum was used, and in an appreciable degree even when no metal was in contact with those artificial compounds, cotton moistened with water being only used to make the different connexions with the fluids.

The author then traces the course of the blood in the fœtus, showing that the blood passes in it, throughout the body, in the direction wholly from artery to vein; the upper half constituting one segment, and the lower half of the body the other segment of the circle; and pointed out that, thus far, there was no antagonism of forces, and therefore no power of generating a galvanic current, which he indicated was supplied by the smaller circle, through the placenta, joining the larger circle at the vena cava, and leaving it at the hypogastric arteries; the smaller circle inducing the current in the larger, in the same manner as the larger circle in the adult may be supposed to induce lesser secondary circles, as the hepatic, &c.

The author then dilates on the importance of the galvanic current in physiological and pathological inquiry; pointing out the peculiar significance of the fact of the reverse current being established as soon as the direct current is impeded; the systemic capillaries being endowed with the power of generating a force exactly the reverse to that set up in the lungs; the rapidity of the circulation thus being, *cæteris paribus*, the measure of the excess of the primary force over the resistance. He infers, that the galvanism found in the muscles owes its origin to the opposed condition of the blood in the capillary network which supplies each; the anastomoses of the arterial capillaries with each other increasing their galvanic surface, while their limited anastomoses with the veins supply the conditions necessary for the passive current. The office of conductors, for the active discharge of the accumulated force, is assigned to the nerves of the voluntary muscles; the author believing that the circuit by which this is effected is, in them, prolonged up to and from the nervous

centres; which centres are, in their turn, shown to be liberally supplied with blood-vessels capable of influencing the galvanic equilibrium. The accelerated respiration caused by increased muscular exertion is attributed to this cause. It is inferred, that the involuntary muscles are provided with apparatus within themselves, adapted to regulate their periodical galvanic discharge. The mutual reaction of distant parts is attributed to the fact of the whole body being included in one galvanic circle, which cannot be disturbed in a part without the whole participating proportionally in the effects.

February 10, 1848.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

"Examination of the Proximate Principles of the Lichens." By John Stenhouse, Esq., Ph.D.

The author, after adverting to the labours of Robiquet, Heeren, Dumas, and Kane in the investigation of the proximate principles of the lichens, especially of those which yield red colouring matter with ammonia, and also of the more recent inquirers on this subject, such as Schunck, Rochleder, Heldt and Knop, who have greatly extended our knowledge of this interesting but difficult department of organic research, proceeds to state that nearly two years ago his attention was directed by Dr. Pereira to a kind of Orcella weed, which had been recently imported into London from the Cape of Good Hope, but which had been rejected by the London archil manufacturers as being unfit for their use, from the small quantity of colouring matter it yields when subjected to the usual process. With a view to ascertain whether or not the red dyes obtained from the various lichens result from the action of ammonia on a certain crystalline principle, described by Schunck under the name of *lecanorine*, the author procured quantities of the several lichens usually employed by the archil makers, and subjected them to investigation; the minute details of which, together with the results, are given at length in the present paper.

The specimens examined are the following:—

I. *South American variety of* Roccella tinctoria.

The lichen was cut into small pieces and macerated with a large quantity of water for some hours, then quick-lime was added. A yellow solution was obtained, from which muriatic acid precipitated the colouring matter, as a bulky gelatinous mass; this was washed, dried on a plate of gypsum, and dissolved in hot spirits of wine (not boiling). The solution on cooling deposited the colouring principle in small white prismatic needles arranged in stars. This is—

1. *Alpha-Orsellic acid* (hydrated) ..... $C_{22}H_{12}O_{12}+HO$

and its salt of baryta—

Alpha-Orselliate of baryta ..... $C_{22}H_{12}O_{12}+BaO$

2. *Alpha-Orsellesic acid* was obtained by mixing crude gelatinous orsellic acid with a little water, neutralizing with lime or baryta, and precipitating with muriatic acid. A gelatinous hydrate is obtained, which may be purified by solution in dilute alcohol and crystallization.

The composition of this acid and its baryta salt is as follows :—

Alpha-Orsellesic acid ..... $C_{16} H_8 O_7 + HO$
Alpha-Orsellesiate of baryta $C_{16} H_8 O_7 + BaO$.

This acid gives a fugitive bluish-red or violet tint with hypochlorite of lime. Orsellic acid gives a deep blood-red tint, quickly changing to yellow.

3. *Orsellesic ether*, $C_{16} H_8 O_7 + C_4 H_5 O$, is obtained from alpha-orsellic acid by boiling in strong alcohol, evaporating to dryness, and dissolving in boiling water. It crystallizes on cooling in long flat needles, having a yellowish colour from adhering resin.

II. Roccella tinctoria *from the Cape of Good Hope.*

By processes similar to those just mentioned, this lichen yielded—

1. *Beta-Orsellic acid*..... $C_{34} H_{17} O_{14} + HO$
Beta-Orselliate of baryta .... $C_{34} H_{17} O_{14} + BaO$.

2. *Beta-Orsellesic acid* (formula to be given hereafter).

3. An ether compound, which is probably orsellesic ether. By three experiments its composition was found to be—

	I.	II.	III.
C	60·82	60·75	60·83
H	6·27	6·15	6·27
O	32·91	33·10	33·00
	100·00	100·00	100·00

4. *Roccellinin.*—Obtained by drying the gelatinous mass which is precipitated from the lime solution by muriatic acid, and boiling in strong spirit. The ether compound dissolves, and roccellinin remains behind. It is purified by repeated crystallization from strong spirit, aided by animal charcoal, and presents itself in soft hair-like crystals about an inch long, arranged in stars. It is a very indifferent substance, appearing however to be a feeble acid.

Its empirical formula is $C_{38} H_{17} O_{15}$.

III. *Roccella Montagnei.*

By similar treatment yielded—

1. *Erythric acid*..... $C_{20} H_{10} O_9 + HO$.

This acid gives a blood-red colour with hypochlorite of lime.

2. *Erythric ether* ..... $C_{20} H_{10} O_9 + C_4 H_5 O$.
3. *Erythric methylic ether* $C_{20} H_{10} O_9 + C_2 H_3 O$.

This ether crystallizes in longer and narrower prisms than erythric ether.

4. *Erythrelesic acid* is analogous to alpha- and beta-orsellesic acids.

5. *Picro-erythrin.*—By neutralizing erythric acid with lime or

baryta, and throwing down erythrelesic acid with muriatic acid, a mother-liquid is obtained containing picro-erythrin, from which that substance may be separated in the form of yellowish crystals; and these may be purified and decolorized by repeated crystallization from hot water aided by the use of animal charcoal. Picro-erythrin gives a blood-red colour with hypochlorite of lime.

Its empirical formula is $C_{24}H_{24}O_{20}$.

6. *Pseudo-orcin*, of which the empirical formula is $C_{10}H_{12}O_{10}$. It is obtained by boiling the lime solution of *R. Montagnei* till it is reduced to one-fourth of its bulk, passing carbonic acid in excess through the liquid, and evaporating the filtered liquid to the consistence of a syrup; this is introduced into a flask and digested with a large quantity of ether, which dissolves orcin and leaves pseudo-orcin. On being crystallized two or three times from strong spirit, it is obtained in large shining colourless crystals. Still larger crystals may be obtained from an aqueous solution. Hypochlorite of lime has no action upon it.

The author then gives a mode of extracting the colouring principles of the lichens, so as to make them portable for commercial purposes. The extraction might be performed in the country where the lichens grow, by cutting them up into small pieces, macerating in milk of lime, neutralizing with muriatic or acetic acid, collecting the gelatinous precipitate on cloths, and drying it at a gentle heat.

He also suggests two modes of estimating the quantity of colouring matter in the lichens.

1. By macerating a known quantity of the lichen in milk of lime, and adding bleaching powder of known strength from an alkalimeter till all colour disappears from the liquid, and noting the quantity of solution required. It is thus found that—

Angola lichen requires.....	200	measures	1·00
American lichen requires.....	120	..	0·60
Cape lichen requires.....	35	..	0·17
Lecanora Tartarea (from Germany, near Giessen) requires.....	25	..	0·12

2. By extracting the lichen with milk of lime, precipitating with acetic acid, collecting the precipitate on a weighed filter, drying and weighing it.

IV. *Evernia Prunastri.*

1. *Evernic acid* is obtained by extracting the lichen with milk of lime, precipitating with muriatic acid, drying the precipitate, and digesting in weak spirit till nearly two-thirds are dissolved. The solution yields crystals of *evernic acid.* The insoluble part is usnic acid. Evernic acid yields only a slight yellow colour with hypochlorite of lime.

Formula of hydrated *evernic* acid ..	$C_{34}H_{18}O_{12}+HO$
Formula of everniate of potash	$C_{34}H_{18}O_{12}+KO$
Formula of everniate of baryta	$C_{34}H_{18}O_{12}+BaO+Aq.$

2. *Evernesic acid* is obtained by dissolving evernic acid in a slight

excess of caustic potash, passing carbonic acid gas through the solution to saturation, and concentrating the solution: evernesiate of potash crystallizes out. From this the acid may be separated by means of muriatic acid. It gives a yellow colour with hypochlorite of lime.

Formula of hydrated acid.....	$C_{18} H_9 O_7 + HO$
Formula of evernesiate of baryta..	$C_{18} H_9 O_7 + BaO + Aq.$
Formula of evernesiate of silver ..	$C_{18} H_9 O_7 + AgO.$

Orcin.

This substance is always obtained when any of the colouring principles of the lichens which yield red dyes with ammonia are subjected to particular processes. The best way of obtaining it pure is to boil the alpha-, or beta-orsellesic acid, or the erythrelesic acid in water for about an hour. Carbonic acid is given off, and crystals of colourless orcin are deposited. It gives a dark purple red colour with hypochlorite of lime, quickly changing into deep yellow.

Empirical formula..... $C_{16} H_{11} O_7$.

Brom-orceide, $C_{16} H_{24} Br O_{13}$ (empirical), is obtained by pouring bromine into a concentrated aqueous solution of orcin; when pure it forms long white adhering needles; it has no taste or smell.

Chlor-orceide, a similar compound, is obtained by passing chlorine gas through a solution of orcin.

Usnic Acid.

This principle is found in *Usnea florida*, *U. hirta*, *U. plicata*, *U. barbata*, *Ramalinea calicaris*, *R. Fraxinia*, *Evernia Prunastri*, and *Cladonia Rangeferina*. It is best obtained from *Cladonia Rangeferina* and *Usnea florida*, by the use of lime and muriatic acid.

Its empirical formula is $C_{38} H_{17} O_{14}$.

February 17, 1848.

GEORGE RENNIE, Esq., Treasurer, in the Chair.

"On a Formula for the Elastic Force of Vapour at different Temperatures." By Captain Shortrede. Communicated by Lieut.-Col. Sykes, F.R.S.

The author adopts as the basis of his formula the first series of experiments at high temperatures made by the French Academy, and those of Magnus at low temperatures. For the Academy's experiments, he adopts the indications of the smaller thermometer in the steam in preference to those of the larger thermometer in the water. Of Dr. Young's sort of formulæ, he notices that of the Academy and several others with exponents varying from 5 to 7. From the elasticity at freezing, as given by Magnus, compared with four of the Academy's experiments, he shows that for the range of obser-

vation the number 6 is preferable to 5 as an exponent; but, as he states, no formula of this sort with a constant index can be found to agree with the observations throughout.

The formula of Magnus he finds to agree with these observations better than any of the others; but being adapted to the air-thermometer, and therefore not convenient for ordinary use, he gives his own formula adapted to the mercurial thermometer,

$$t = \frac{500 + 225 \log A}{5 - \log A},$$

t being the temp. Cent., and A the elasticity in atmospheres of $0^{m}{\cdot}76$ at zero, or 30 inches at 58° Fahr.; ∴ the temperature being given, the formula becomes

$$\log A = 5 - \frac{1625}{225 + t}.$$

The author compares with the experiments the formula of the Academy and those of Southern, Coriolis, Tredgold, and one deduced as above; also that given by August, and the same modified so as to give at freezing the elasticity found by Magnus; also that of Magnus, and the same reduced to the mercurial thermometer by the data of Dulong and Petit; and lastly, his own formula. Then assuming that the experiments of Magnus are represented by his formula, he compares the other formula with it at every 10° from −10° to 100° Cent. He shows that for the range of their experiments the Academy's formula is better than the others of Dr. Young's sort; but at low temperatures it is very erroneous. Southern's formula at low temperatures is better than that of Coriolis, but at high temperatures not so good. Tredgold and the other like it are better at low temperatures than that of Coriolis, but worse at high temperatures. August's formula is very erroneous; and in its modified form it is still worse, the errors increasing to about 10° or more, showing that the theoretic considerations by which it is deduced are not founded in truth. With the Academy's experiments, the errors of Magnus's formula are −, but when reduced to the mercurial thermometer they are all +, the mean of the whole being $0^{\circ}{\cdot}33$. With the new formula the errors are nearly balanced, the sums on the thirty experiments being $-1^{\circ}{\cdot}78$ and $+3^{\circ}{\cdot}55$, in only two cases amounting to half a degree. On the twelve experiments, at or near the maximum, the errors are $-1^{\circ}{\cdot}12$ and $+0^{\circ}{\cdot}43$.

From zero to 100° the differences between the new formula and that of Magnus are all of one kind; and when reduced to temperature are less than $0^{\circ}{\cdot}4$, which the author thinks to be within the probable difference between the air and mercurial thermometers, and within the errors of observation.

He then gives a table of temperature corresponding to elasticity of vapour in atmospheres. Also modifying his formula,

$$\log f 6{\cdot}47712125 - \frac{2925}{373 + t},$$

to give f = the elasticity in inches of mercury for temp. Fahr., he gives a table of f for every degree from $-40°$ to $+360°$, by the help of which he compares with his formula, the experiments of Robison, Southern, Dalton, Taylor, Arsberger, Ure, and those of the American Committee, and shows that they differ more widely from each other than from the formula.

Considering the care bestowed to ensure the elasticities being correctly measured, the author is disposed to attribute a great part, but not the whole, of the discordance on the several results to errors in the measures of temperature arising from smallness of scale or incorrectness of division.

February 24, 1848.

GEORGE RENNIE, Esq., Treasurer, in the Chair,

"On the Moist-Bulb Problem." By Captain Shortrede. Communicated by Lieut.-Colonel W. H. Sykes, F.R.S.

The author adopts the notation of Professor Apjohn, and by a similar method deduces the fundamental equation, which is then translated into numbers, taking 1175° F. as the sum of the latent and sensible heats, 0·267 as the specific heat of dry air, the weight of aqueous vapour as five-eighths of that of air, and its specific heat =0·867, that of water being unity.

The coefficient for barometric pressure is resolved into a simple change on the temperature of the air, and consequently also on the depression of the moist bulb; and the equation is put into a shape convenient for use, and shown to be free from objection. The author uses the table of the force of vapour, given in the accompanying preceding paper, and then gives a table of maximum depressions for every degree of the moist bulb from $-40°$ to 212°, and another table interpolated from it for every degree of temperature of the air from 0° to 212°.

Gay-Lussac's depressions are then compared with those of the new formula; and the errors are shown to be almost insensible near the freezing-point, but increasing gradually, till at 25 Cent. it is about 10 per cent. The author attributes these errors to the gradual deterioration of the chloride of lime during the experiments.

The author then compares Prinsep's maximum depressions collected and given in vol. v. of the Journal of the Asiatic Society of Bengal. The observed depressions are generally below those given by the new formula, like those of Gay-Lussac. The errors on those where the air was heated by a steam-pipe, are not greater than on those at natural temperatures; and that with air passing through a porcelain tube at an orange heat, falls within the limits assigned by Prinsep in estimating the temperature of the air.

Apjohn's maximum depressions are then compared with the new formula. And here the errors are of an opposite character to those preceding, which the author attributes to the lowering of tempera-

ture occasioned by expansion on escaping from the compression used to force the air in a rapid current through the apparatus. Apjohn's dew-point observations are then compared, and the errors are found to be similar to the preceding, and apparently from the same cause.

To make the formula generally useful, the author gives a table of the depression of dew-point below temperature for every degree of depression of the moist bulb, at every 5° of temperature from 0° to 100°, and for every 10° from 100° to 140°, which he protracts on a chart, so as to give the dew-point in every case with little more trouble than is required for reading a common thermometer, and also at the same time the elasticity of vapour in the atmosphere.

"Experiments on the influence of Magnetism on Polarized Light." By Professor Carlo Matteucci. Communicated by Sir John F. W. Herschel, Bart., V.P.R.S. &c.

The object of this notice is to communicate some recent experiments on diamagnetism, and particularly on the influence of magnetism on polarized light. The following extracts are in the words of the author:—

"The apparatus I employed in these experiments was an electro-magnetic apparatus invented by M. Rumkorf, and described by M. Biot at a meeting of the Academy of Sciences of Paris, and consisting of a powerful electro-magnet, of which the soft iron cylinder is traversed by a hole in the direction of the length of the axis, through which hole the ray of polarized light is made to pass; and the voltaic current which I employed on this occasion was that of seven pair of Grove's construction. I made my first experiment with a piece of *heavy glass*, which I received from Faraday himself. In order to assure myself of the exact amount of rotation induced by magnetic action, I caused the ray of light, before it reached the heavy glass, to pass through the system invented by M. Soleil, consisting of two equal plates of perpendicular quartz, placed side by side; the one turning to the right, the other to the left. I ascertained, first of all, the rotation produced by making the current pass sometimes in one direction, and sometimes in the other; the two rotations, one to the right, the other to the left, thus produced, were exactly the same. Then I compressed slightly the middle part of the piece of heavy glass, in the same manner as one compresses pieces of glass. I was then obliged to turn the eyepiece in a certain direction in order to restore the image to its first condition; in my experiments I always had to turn it, after compression, towards the right. I next made the current pass, first in one direction, then in the other. The general facts which I have observed constantly and without exception are the following:—*The rotation produced by the magnet on the compressed piece of heavy glass is not the same to the right as it is to the left: the rotation produced by the magnet is considerably greater in the direction of the rotation produced by compression than it is in the contrary direction: the rotation produced by the magnet on the compressed heavy glass, and in the direction of the rotation produced by the compression, is greater than that produced by the same magnet on glass*

which has not been compressed, and the rotation in the contrary direction is less. The following are the numerical results.

"In one experiment I obtained on a piece of heavy glass not compressed, 3° of rotation to the right or to the left, according to the direction of the current: on slightly compressing the glass, I had to turn to the right the eyepiece to 4°, 5°, and even to 8° in order to restore the image to its first condition. In closing the circuit, the rotation produced in the same direction as that due to compression was $3\frac{1}{2}$° or 4°, while the rotation produced in the contrary direction was from 2° to $1\frac{1}{2}$°. On ceasing to compress the glass, I obtained the same phænomena as I had observed before the compression.

"I have made in the same manner experiments with a piece of flint-glass, which produced a rotation of 2° under the influence of the magnet. When I applied the same magnet to pieces of compressed flint-glass, I could not discover the slightest sensible rotation in whatever direction I might make the current pass. Plates of quartz cut perpendicularly or parallel to the axis, and compressed in various directions, did not acquire any rotatory power under the influence of the magnet. I think that the peculiarity exhibited by compressed heavy glass is of some interest, in as far as it appears likely to lead to a more satisfactory explanation of the want of rotatory power communicated by magnetism in crystalline bodies.

"I shall conclude by communicating the negative results of some experiments I attempted with a view to discover the action of diamagnetic bodies on each other, and of magnetism on gaseous bodies. I suspended small needles of bismuth between the poles of a very powerful electro-magnet, and with a good chronometer I counted the number of their oscillations, either alone or in the vicinity of pieces of bismuth of various shapes and sizes. I repeated these experiments with all possible care, avoiding the slightest current of air, reckoning the smallest oscillations, and those of the same extent in the different cases. I never obtained any differences beyond half a second, which existed equally whether the pieces of bismuth were near or not. The experiment therefore does not serve to show the action of diamagnetic bodies on each other; an action which naturally ought to exist, but which perhaps is overpowered by the stronger action of the magnet.

"I afterwards counted the oscillations of a small needle of bismuth, which I succeeded in suspending by a silk fibre (*fil de cocon*) inside of a glass ball blown at the top of a barometer-tube. The ball was placed between the poles of my electro-magnet. In this experiment the bismuth needle was held sometimes in a nearly perfect vacuum, at others in atmospheric air. The number of oscillations in both cases was exactly the same.

"We must therefore give up the idea of explaining diamagnetic phænomena by a magnetic action, which would be stronger upon the air than upon bismuth."

March 4, 1848.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

"On the Corrections necessary to be applied to Meteorological Observations made at particular periods, in order to deduce from them Monthly Means." By James Glaisher, Esq., of the Royal Observatory. Communicated by G. B. Airy, Esq., F.R.S., &c., Astronomer Royal.

The author, under whose immediate superintendence the whole of the magnetical and meteorological observations taken at the Royal Observatory at Greenwich have been conducted, by direction of the Astronomer-Royal, has communicated in the present paper various tabular results deduced from the meteorological observations, reserving for future notice those deduced from the magnetical series. His chief object has been to determine the corrections which are applicable to the results obtained by different observers at various times, so as to render them comparable with one another. The barometrical and thermometrical observations here recorded have been made at every hour of Gottingen mean solar time, during the whole of five years, namely, from the end of 1840 to that of 1845. The mean of each hour represents the results deduced from about 150 observations; those for each month represent about 1800 observations; and those for the year represent upwards of 21,000 observations of each element.

Tables are given representing the excess of the mean value of each element at every hour of observation, in every month, above the mean value for the month; and also the mean of the numbers so found, arranged for the different years, and likewise for the same hours in every month. The numbers were then laid down on paper, as ordinates to a curve of which the times were the abscissæ, and a curve passed through, or very near each point; and the ordinates at every Greenwich hour were measured from that curve, and their values given in a table. The accordance of the results thus obtained for the same hours in the same months of the different years is very close and satisfactory; and shows that observers may obtain very valuable approximate results, by taking a comparatively small number of observations in each day at hours by no means inconvenient in ordinary life, furnishing a close approximation to the mean and extreme values, as well as to the diurnal and annual variations of atmospherical phenomena.

March 9 and 16, 1848.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

"Report of Experiments made on the Tides in the Irish Sea; on the similarity of the Tidal phenomena of the Irish and English Channels; and on the importance of extending the experiments round the

Land's-End and up the English Channel." Embodied in a letter to the Hydrographer, by Captain F. W. Beechey, R.N., F.R.S. Communicated by G. B. Airy, Esq., F.R.S., Astronomer Royal.

The author commences by stating, that the set of the tides in the Irish Sea had always been misunderstood, owing to the disposition to associate the turn of the stream with the rise and fall of the water on the shore. This misapprehension, in a channel varying so much in its times of high water, could not fail to produce much mischief; and to this cause may be ascribed, in all probability, a large proportion of the wrecks in Caernarvon Bay.

The present inquiry has dispelled these errors, and has furnished science with some new and interesting facts. It has shown that, notwithstanding the variety of times of high water, the turn of the stream throughout the north and south Channels occurs at the same hour, and that this time happens to coincide with the times of high and low water at Moricombe Bay, a place remarkable as being the spot where the streams coming round the opposite extremities of Ireland finally unite. These experiments, taken in connexion with those of the Ordnance made at the suggestion of Professor Airy, show that there are two spots in the Irish Sea, in one of which the stream runs with considerable rapidity, without there being any rise or fall of the water, and in the other the water rises and falls without having any perceptible stream; that the same stream makes high and low water in different parts of the channel at the same time; and that during certain portions of the tide, the stream, opposing the wave, runs up an ascent of one foot in three miles, with a velocity of three miles an hour.

The author then enters minutely into the course of the stream; shows that the point of union of the streams from the opposite channels takes place on a line drawn from Carlingford through Peel in the Isle of Man on to Morecombe Bay; and concludes his remarks on this part of the subject, by adverting to the great benefit navigation will derive from the present inquiry.

The author then notices a chart of lines of equal range of tide, which has been compiled partly from the ranges published by the Royal Society*, and partly from observations made on the present occasion; and has annexed a table†, by the aid of which the seaman will be able to compare his soundings taken *at any time of the tide* with the depths marked upon the Admiralty charts.

Next follows the mention of a feature in the motion of the tide-wave, which Captain Beechey thinks has hitherto escaped observation; viz. that the upper portions of the water fall quicker than the lower, or in other words, that the half-tide level does not coincide with the place of the water at the half-tide interval; that this difference in the Bristol Channel amounts to as much as four feet‡, and that the law seems to be applicable to all the tides of the Irish Sea§.

We are next presented with a table (No. 5) exhibiting the various

* Philosophical Transactions, 1836, part 1. † Table X.
‡ See Diagram, No. 9. § Diagram, No. 11.

curves assumed by the tide-wave, and with the durations of the ebb and flood at each place.

Having explained these observations in the Irish Sea, the author proceeds to apply to the tides of the English Channel the law which he found to regulate the stream of the Irish Channel, availing himself of the observations of Captain M. White and others for this purpose. There was no difficulty in adapting the rule in the upper part of the Channel; but below the contraction of the strait, the apparent discordance was so great, that nothing but a reliance on the general accuracy of the observations prevented the inquiry being abandoned.

It seemed that the streams are operated upon by two great forces, acting in opposition to each other; viz. that there is a great offing stream setting along the western side of the British Isles, and flowing in opposition to the tides of the Channel above the contraction, turning the stream with greater or less effect as the site is near to, or removed from, the points of influence. By pursuing this idea, it was immediately seen that the observations in the English Channel respond to it; and then applying it to the offing of the Irish Sea, and considering that channel to comprise within its limits the Bristol Channel, as the English Channel does the Gulf of St. Malo, it was found that the observations there also fully bear out the idea. So that there was afterwards but little difficulty in tracing the course of the water, and bringing into order what before appeared to be all confusion.

The author then traces the great similarity of tidal phenomena of the two channels, and proceeds to describe them. For this purpose he considers the Irish Channel as extending from a line connecting the Land's End with Cape Clear to the end of its tidal stream, or virtual head of the tide at Peel; and the English Channel from a line joining the Land's End and Ushant, to the end of its tidal stream off Dungeness. With these preliminary lines, he shows that both channels receive their tides from the Atlantic, and that they each flow up until met by counter-streams; that from the outer limit of the English Channel to the virtual head of its tide the distance is 262 geographical miles; and in the Irish Channel, from its entrance to the virtual head of its tide, it is 265 miles.

In both channels there is a contraction about midway; by Cape La Hague in the one, and by St. David's Head in the other, and at nearly the same distance from the entrance. In both cases this contraction is the commencement of the regular stream, the time of the movement of which is regulated by the vertical movement of the water at the virtual head of the channel; situated in both cases 145 miles above the contraction, and the actual time of this change, or Vulgar Establishment, is the same in both cases. Below the contraction of the strait, in both cases the stream varies its direction according to the preponderance of force exerted over it by the offing stream. In both cases, between the contraction and the southern horn of the channel, there is a deep estuary (the Bristol Channel and the Gulf of St. Malo) in which the times of high water are nearly the same, and where, in both, the streams, meeting in the channel,

pour their waters into these gulfs, and in both raise the tide to the extraordinary elevation of forty-seven feet. From the Land's End to the meeting of these streams in one case is seventy-five miles, and in the other the same.

In one channel, at Courtown, a little way above the contraction, and at 150 miles from the entrance, there is little or no rise of the water; and in the other, about Swanage, at the same distance from the entrance, there is but a small rise of tide also (five feet at springs). In both cases these spots are the node or hinge of the tide-wave, on either side of which the times of high water are reversed. And again, near the virtual head of the tide, in both cases there is an increased elevation of the water on the south-east side of the channel of about one-third of the column; the rise at Liverpool being thirty-one feet, and at Cayeux thirty-four feet.

The author traces a further identity in the progress of the tide-wave along the sides of both channels *opposite to that of the node.* In the first part of the channel the wave in each travels at about fifty miles per hour; in the next, just above the node, this rate is brought down to about thirty miles per hour in one, and to sixteen miles in the other; it then in both becomes accelerated, and attains to about seventy-six miles per hour.

Lastly, the author observes that the node or hinge of the tide, placed by Professor Whewell (in his papers on the Tides) in the North Sea, is situated at the same distance nearly from the head of the tide off Dungeness, as the node near Swanage is on the opposite side of it; and that in the Irish Channel, at the same distance nearly as the node at Courtown is from the head of the tide off Peel, there is a similar spot of no rise recently observed by Captain Robinson.

The author concludes this paper by urging a further investigation of the tidal phenomena of the English Channel, on the ground of the great advantage navigation, as well as science in general, would derive from such an examination.

Captain Beechey's letter is illustrated by twelve charts and diagrams, showing the identity and singular phenomena of these two great channels.

March 23, 1848.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

"Observations on some Belemnites and other fossil remains of Cephalopoda, discovered by Mr. Reginald Neville Mantell, C.E., in the Oxford Clay, near Trowbridge in Wiltshire." By Gideon Algernon Mantell, Esq., LL.D., F.R.S., Vice-President of the Geological Society.

The author states, that a line of railway now in progress of construction to connect the large manufacturing town of Trowbridge with the Great Western, being part of the Wilts, Somerset, and

Weymouth line, traverses extensive beds of the Oxford clay of the same geological character as those at Christian-Malford in the same county, which furnished the remarkable fossil cephalopods described by Mr. Channing Pearce under the name of *Belemnoteuthis*, and by Professor Owen (in a memoir which received the award of a Royal Medal of this Society), as the animals to which the fossils commonly known by the name of *Belemnites* belong.

The son of the author, Mr. R. N. Mantell, being engaged in these works under the eminent engineer Mr. Brunel, availed himself of the opportunity to form an extensive and highly interesting collection of the fossils of the Oxford clay, and other oolitic deposits cut through or exposed by the engineering operations. Among those transmitted to the author are many illustrative examples of Belemnoteuthes and Belemnites; some of which confirm the opinions entertained by the late Mr. C. Pearce, Mr. Cunnington, and other competent observers, that the body and soft parts, with the cephalic uncinated arms, &c. of cephalopods, obtained from Christian-Malford by the Noble President and Mr. Pearce Pratt, and referred by Professor Owen in the memoir above-mentioned to the Belemnite, belong to a distinct genus—the Belemnoteuthis.

The author describes and figures several perfect examples of the phragmocone of the Belemnoteuthis, and institutes a comparison between them and a beautiful example of the phragmocone of a belemnite occupying the alveolus of the guard; and defines the essential differences observable in the form and structure of these chambered calcareous cones. He especially points out as distinctive characters of the phragmocone of the Belemnoteuthis, two flat longitudinal ridges which extend upwards from the apical extremity, and the granulated and striated external surface of the epidermis. The phragmocone of the Belemnite has a smooth surface, is destitute of any longitudinal ridges, and terminates at the apex in a very fine point, the axis being in an oblique direction.

The author next describes a remarkable specimen of a Belemnite, twenty-two inches in length, in which the osselet or guard, phragmocone, and capsule or receptacle, are preserved in connexion. In this fossil is demonstrated, for the first time, the upper or basal termination of the phragmocone, with two elongated calcareous processes extending upwards from the margin: these are analogous in form and position to the prolongations from the peristome of the outer chamber of certain Ammonites, as for example, in *A. Jasoni*. In the phragmocone of the Belemnoteuthis the peristome is entire.

Another interesting part of the structure of the Belemnite, not previously detected, is also shown in the same specimen, as well as in many other examples found in the Oxford clay near Trowbridge; namely, a calcareous shelly periosteum or capsule, which invests the guard, and expands upwards into a horny sheath or receptacle, that surrounds the basal chamber of the phragmocone in which the viscera were probably contained. This receptacle was formerly supposed to originate from within the alveolus of the guard. Mr. Miller, many years ago, inferred the existence of a vascular integument around

the guard from the meandring impressions of blood-vessels observable on the surface of some specimens; but the presence of a calcareo-corneous capsule or sheath investing the guard, and expanding into a horny receptacle, has not till now been demonstrated.

The author considers the facts described as proving that the cephalopod of the Belemnite was entirely distinct from the Belemnoteuthis; and that the muscular mantle, cephalic arms, and other parts referred by Professor Owen to the former, exclusively belong to the latter genus.

He concludes that the remains of at least three genera of naked Cephalopoda occur in the argillaceous deposits of the oolite in Wiltshire; namely, the first or true *Calamary*, with a horny dorsal gladius or pen; the second, the *Belemnoteuthis*, or a decapod with uncinated cephalic arms, ink-bag, pallial fins, and a corneo-calcareous phragmocone; and the third, the *Belemnite*, which possessed a phragmocone having the apical part implanted in the cavity or alveolus of a guard or osselet, which in its original state resembled in substance the sepiostaire of the Cuttle-fish, but is generally found mineralized by calcareous spar; and the peristome, possessing two or more elongated shelly processes; both the guard and the phragmocone being invested with a corneo-calcareous capsule or receptacle. He observes, lastly, that the body and other soft parts of the cephalopod of the Belemnite are at present unknown. The author's communication was illustrated by drawings, and accompanied by the specimens above described.

March 30, 1848.

The MARQUIS OF NORTHAMPTON, President, in the Chair.

Professor Ritter, of Berlin, and M. Milne Edwards, of Paris, were elected Foreign Members.

"Chemical Researches on the Nature of Wax." By Benjamin Collins Brodie, Esq. Communicated by Sir Benjamin Collins Brodie, Bart., F.R.S.

It is known that bees'-wax is separable, by means of boiling water, into two portions: to the one, which is more soluble in alcohol than the other portion, the name of *Cerin* has been given: the residuary portion, which does not dissolve, has been termed *Mycicin*. In this paper the author gives an account of his investigation of the properties of the former of these substances, namely Cerin.

This substance has been represented by certain chemists in France, M. Lewy and M. Gerhardt, as being convertible by oxidation into the stearic acid, and as being a substance which stands with respect to that acid in the remarkable relation of an aldehyde. These views the author believes are incorrect; and he states that no pure chemical substance was procured by these chemists from cerin, and that the

substance of which the greater part of the cerin consists is no aldehyde, but a hydrated acid, existing as such in bees'-wax.

The acid is best prepared by precipitation from the alcoholic solution of the cerin by an alcoholic solution of acetate of lead, and subsequent separation and precipitation of the acid by methods described in the present paper. When purified, the acid is a white brittle body, of a crystalline appearance, melting at from 79° to 80° C. The formula of the acid is $C_{54}\ H_{54}\ O_4$, a formula which was determined by the analysis of the silver salt having the constitution $C_{54}\ H_{53}\ O_3 + AgO$, and of the compound ether $C_{58}\ H_{58}\ O_4 = C_{54}\ H_{53}\ O_3 + C_4\ H_5\ O$. The acid is volatile: it was analysed after distillation; and it was also procured from the wax itself in a pure state by simple processes of crystallization. To this acid the author gives the name of *Cerotic acid*.

By the action of chlorine, the wax acid is converted into a substance having all the appearance of a gum-resin; a change analogous to which may be effected in various other wax substances examined by the author. It has still the characters of an acid, and has the formula $C_{54}\left\{\begin{matrix}H_{42}\\Cl_{12}\end{matrix}\right.O_4$, a formula which is confirmed by that of the compound ether $C_{58}\left\{\begin{matrix}H_{46}\\Cl_{12}\end{matrix}\right.O_4$. The analyses of these substances are given.

When distilled in a pure state, the cerotic acid is volatile. When mixed with other waxy matters, however, it passes by distillation entirely into volatile oils, a circumstance which accounts for the fact that it has never been dissolved in the wax distillate. By precipitating a weighed quantity of wax by acetate of lead, the quantity per cent. of the cerotic acid in the bees'-wax, namely 22, was determined.

This acid was present in all the European bees'-wax examined by the author; but suspecting that its quantity might vary in other instances, he procured bees'-wax from Ceylon, formed under different conditions of climate and vegetation, and found on examination that there was a total absence of the acid in that specimen. The author draws attention to this curious variation in the nature of an animal secretion under different conditions of life, a variation of which we have another example in that of the volatile acid of butter, discovered by Leich; namely, that the butyric and caproic acid of one season were, in another, replaced by vaccinic acid, differing from the former acids in the amount of oxygen alone.

"A statement of the working of the Compasses on board the Honorable East India Company's Iron Steamer Pluto, from September 1841, on her passage from England to China, and during her service in those seas, until her arrival at Calcutta in January 1843." By John Tudor, Commander R.N. Communicated by S. Hunter Christie, Esq., Sec. R.S., &c.

The author states that the compasses of the Pluto were adjusted by Mr. Sims, of the firm of Troughton and Sims, by order of Mr.

Pencoote of the East India House, under whose directions that ship was fitted out; and it is to the great pains taken by Mr. Sims in placing the magnets employed for counteracting the local attraction that the author attributes the undeviating accuracy of those compasses during the whole time the Pluto was under his command in both hemispheres. He observes that, in the first place, much care is required in securing the magnets, and protecting them from wet, after their proper position has been ascertained. In the case of the Pluto, two magnets were placed under the deck in the author's cabin; one of them eighteen inches below the deck, being, it is true, an eyesore, but one of trifling consideration, when compared with the great importance of the well-working of the compass. The next point to be attended to is that the cards, or needles, should be all of the same size, and exactly corresponding with that of the compass used at the placing of the magnets for counteracting the local attraction. The bittacles should all be of the same make and height, and the compass-boxes of the same size; so that whenever a new compass or a fresh bittacle is wanted, the circle in which the needle moves may remain at the same angle from the magnet as at the first adjustment. On a strict attention to these precautions will depend the well-working of the compass in all iron vessels, and also in wooden vessels whenever the quantity of iron they contain creates the necessity of measures being taken for counteracting local attraction.

It has been alleged that the adjustments for local attraction made in northern latitudes are not correct when the ship is south of the equator; but the author states that, in the Pluto, he observed no difference; that ship having made, while under his command, passages of many thousand miles, comprising 94 degrees of latitude, namely from 51° North to 43° South, and 153 degrees of longitude, namely from 30° West to 123° East, during the whole of which he never found any other correction for the compasses necessary excepting that required for the magnetic variation, the local attraction having been completely neutralized.

A diagram is subjoined, showing the positions of the compensating magnets with relation to the compass.

"Practical Remarks on Annealing Flint-Glass." By Apsley Pellat, Esq., of the Falcon Glass Works, Holland Street. Communicated by Joshua Field, Esq., F.R.S.

This paper is entirely occupied with practical details relating to the art of annealing flint-glass and depriving it of colour, the author stating that he leaves the rationale of these facts to be explained by philosophers. He thinks, however, that they are reconcileable with the theory of Scheele, as explained by Bergman, and detailed by Murray in his work on Chemistry.